中華民國天文學會 2009 年研討會論文摘要
Abstracts of ASROC Symposium 2009

Plenary Talks and Public Lecture / 大會邀請演講與科普講座

Searching for Other Earths and Life in the Universe

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ABSTRACT

It was 400 years ago that Galileo gazed innocently toward the heavens with a telescope, displacing the Earth from its central pedastal. Since then, telescopes have placed our Solar System and our Milky Way Galaxy in their proper contexts within the universe. But profound questions remain about the commonality of other Earths and about life in the universe. Science fiction offers a model of our Milky Way Galaxy teeming with habitable planets populated by advanced civilizations that engage in interstellar travel and exploration. But in our real universe, Earth-like planets and alien life have proved elusive. Where are they? Habitable earths may be more precious than currently realized. This month, on March 6, NASA launched the Kepler telescope from the Kennedy Space Center, designed to carry out humanities' first search for Earth-like worlds around other stars. A wild race to discover habitable and inhabited worlds is about to begin.

Introduction to NAOJ

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ABSTRACT

The facilities and recent activity of National Astronomical Observatory of JAPAN (NAOJ) is introduced. In NAOJ we have various observatories, Subaru Telescope in Hawaii Observatory, 45m radio telescope and heliograph in Nobeyama observatory, Okayama observatory and Mizusawa VERA observatory and so on. I will show the recent scientific results from those observatories. And I will show the recent progress of ALMA which is under construction under collaborative work with Taiwan, North America and Europe. I would like to emphasize that NAOJ facilities are open to the Japanese communities and also to foreign researchers. Therefore I would like to proceed international cooperative work in the field of astronomy, especially with Taiwan community. The future plan of NAOJ is also introduced. I explain new instruments for Subaru telescope and I would like to refer to ELT (Extreme Large Telescope) project.

天外有天：從單一宇宙到多重宇宙 From Universe to Multiverse

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ABSTRACT

This year celebrates the 400th anniversary of Galileo's revolutionary discoveries on our universe using his own telescope. Among his seminal discoveries was his proof that the Sun, not the Earth, was the center of the world. Since then our understanding of the universe continues to expand. We now know that the Sun is one of the 100 billion stars in the Milky Way Galaxy, and our galaxy is just one of 100 billion galaxies in the observable universe. One then naturally wonders, following this Copernican dictum, is our universe unique? Are there more universes in addition to our own? In parallel with the advancement in astronomy, there has been also tremendous progress in physics over the centuries since Galileo's time that has revolutionized our understanding of the nature. By now physicists have developed the "standard model of particle physics". Together, we by now have developed a "standard model of cosmology". In this lecture I will give an overview on what we know about our universe from the standard models of particle physics and cosmology, the inflation, to the wonders of dark matter and dark energy. Towards

the end I will return to the question: Can there be more than one universe?

Scientific Oral Presentations / 科學論文宣讀

SMA and CARMA Observations of Young Brown Dwarfs in rho Ophiuchus and Taurus

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ABSTRACT

Studying the earliest stages in the birth of stars is crucial for understanding how they form. Brown dwarfs with masses between that of stars and planets are not massive enough to maintain stable hydrogen-burning fusion reactions during most of their lifetime. Their origins are subject to much debate in recent literature because their masses are far below the typical mass where core collapse is expected to occur. Based on SMA and CARMA observations, we present the first detections of bipolar molecular outflows from young brown dwarfs in rho Ophiuchus and Taurus. Our results demonstrate that the bipolar molecular outflow operates down to brown dwarf masses, occurring in brown dwarfs as a scaled-down version of the universal process seen in young low-mass stars.

Millimeter- and Submillimeter-Wave Observations of Barnard 1-bN and Barnard 1-bS

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ABSTRACT

The physical and chemical properties of two mm/sub-mm sources in Barnard cloud, Barnard 1-bN and Barnard 1-bS, are studied with multi-wavelength observations. The dust continuum from these two sources shows spatially compact distribution and very cold spectral energy distributions (T_{dust}=10-16 K). These two sources have no mid-IR counterpart in the Spitzer MIPS 24 and 60 micron bands, indicating that they are deeply embedded. The CO J=2-1 data obtained with the SMA suggest that B1-bS and probably B1-bN are associated with the compact (~ 2000 AU size) molecular outflows. These results propose that Barnard 1-bN and Barnard 1-bS are already harboring Class 0 protostars. On the other hand, the chemical properties of these two sources are similar to those of pre-stellar cores: the N_2D^+ J=3-2 emission is strongly detected (0.3 K for B1-bN and 0.1 K for B1-bS) and clearly traces the two compact sources, while the $H^{13}CO^+$ J=1-0 emission is weak or barely detected near or at the continuum peaks. This lack of $H^{13}CO^+$ emission is probably due to the depletion of the $H^{13}CO^+$ molecule onto the grain under the condition of low temperature and high density, as in the case of pre-stellar cores. The observed physical and chemical properties suggest that B1-bN and B1-bS are in the very beginning stage of protostellar evolution, probably in the evolutionary stage between pre-stellar core and class 0 source.

SMA Observation of a Very Low Luminosity Object

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ABSTRACT

We present Submillimeter Array (SMA) observation of a Very Low Luminosity Object (VeLLO) SSTc2d J032839.10+310601.8 in Perseus. VeLLOs are believed to be the youngest YSOs hence provide a great opportunity to study the initial condition of star formation. Our result show a slightly flattened

continuum at the position of YSO and the N_2D^+ emission has long axis ~ 6000 AU with the same elongation direction as continuum. The flattened N_2D^+ emission has a velocity gradient along the long axis direction, which may be an indicator for a rotating disk or pseudodisk.The ^{12}CO, ^{13}CO and $C^{18}O$ data hint the existence of velocity gradient, which is not consistent with the apparent outflow feature in Spitzer's IRAC2 band. Therefore, we suggest that the outflow feature in IRAC2 may not come from SSTc2d J032839.10+310601.8, but from a nearby source IRAS03256+3055, in agreement with the observations in Hodapp et al. (2005).Future single dish observations are need to recover the large scale structure in order to investigate the origin of the velocity gradient.

Young Stellar Population in the Lupus Molecular Clouds

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ABSTRACT

The Lupus molecular cloud complex is a nearby star-forming region in the southern sky. Some of the molecular clouds in the region are associated with obvious ongoing star-forming activities (e.g., Lupus 1), while some without (e.g., Lupus 5). The Lupus 3 cloud has the highest molecular column density and hosts the largest number of T Tauri stars, signifying recent, active star formation. In contrast, the Lupus 5 cloud is not associated with any known young stars or star formation. We used archival UK Schmidt Telescope H-alpha Sky Survey and 2MASS point-source catalog to identify candidate low-mass pre-main sequence stars, namely the classical T Tauri stars (CTTSs), that are characterized by H-alpha emission and near-infrared excess. Some of the bright candidates were observed by optical spectroscopy. In Lupus 3, almost all known CTTSs were found in our study. In addition, we identified 4 candidates H-alpha stars not previously catalogued. Two of these show a very strong H-alpha line in emission and prominent near-infrared excess---hence should be bona fide CTTSs---yet are located away from the densest parts of the molecular cloud so overlooked by earlier surveys. This suggests that the young stellar sample, thus the star formation history, in the region may be largely incomplete. The other two H-alpha stars were spectroscopically confirmed to be active chromospheric M dwarfs (dMe stars). Extending our analysis to Lupus 5, we found only one candidate whose spectrum indeed shows the H-alpha line, but without notable near-infrared excess. This H-alpha star therefore is likely a dMe, rather than a young star. Our study thereby confirms that the Lupus 5 cloud is quiescent in star formation.

The Atomic Hydrogen of Titan Dancing in the Saturnian Magnetosphere

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ABSTRACT

Titan has a substantial atmosphere mainly composed of N2, CH4 and H2. Cassini INMS measurement showed that Titan has large escape rates of CH4, H2 and their atomic fragments. The atmospheric escape could be a result of thermal escape, chemical-induced escape, slow hydrodynamic escape, pick-up ion loss and ionospheric outflow, and plasma-ion-induced atmospheric sputtering. The escape rate of the exospheric H atoms has been estimated to be 6.0×1027 atoms/s. After leaving Titan, the H atoms will move in circumplanetary orbits under the influence of the long-term perturbation effects of solar radiation pressure and the J2 term due to Saturn's oblateness. In the present work, a Monte-Carlo model has been developed to trace the orbital evolution of Titan's atomic hydrogen torus as Saturn moves around the Sun. In addition, we will compare the Titan's exospheric atomic hydrogen component to the atomic hydrogen fragments which are created by the photodissociation of H2 emitted by Titan and H2O emitted by Enceladus.

Neptune Migration Model with One Extra Planet

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ABSTRACT

We explore conventional Neptune migration model with one additional planet of mass at 0.1-2.0 $M_\oplus$.

This planet inhabited in the 3:2 mean motion resonance with Neptune during planet migration epoch, and then escaped from the Kuiper belt when Jovian planets parked near the present orbits. Adding this extra planet and assuming the primordial disk truncated at about 45 AU in the conventional Neptune migration model, it is able to explain the complex structure of the observed Kuiper belt better than the usual Neptune migration model did in several respects, which are the following. (1) High-inclination Plutinos with I = 15°-35° are produced. (2) Generating the excitation of the classical Kuiper belt objects, which have moderate eccentricities and inclinations. (3) Producing the larger ratio of Neptune's 3:2 to 2:1 resonant particles, and the lower ratio of particles in the 3:2 resonance to those in the classical belt, which may be more consistent with observations. (4) Finally, several Neptune's 5:2 resonant particles are obtained. However, numerical experiments imply that this model is a low-probability event. In addition to the low probability, two features produced by this model may be inconsistent with the observations. They are small number of low-inclination particles in the classical belt, and the production of a remnant population with near-circular and low-inclination orbit within a = 50-52 AU. According to our present study, including one extra planet in the conventional Neptune migration model as the scenario we explored here may be unsuitable because of the low probability, and the two drawbacks mentioned above, although this model can explain better several features which is hard to produce by the conventional Neptune migration model. The issues of low-probability event and the lack of low-inclination KBOs in the classical belt are interesting and may be studied further under a more realistic consideration.

The Formation of the Low Latitude Boundary Layer in Mercury Magnetosphere: A 3D Hybrid Simulation Study

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ABSTRACT

Mercury's magnetosphere is a poor known system which couples directly to the surface but is hardly affected by the tenuous ionosphere. We performed a 3D hybrid model to simulate the Hermean system without injecting any planetary ions. The results showed that the solar wind ions could penetrate into the magnetosphere, accumulate at low latitudes, and form an ion boundary layer inside the magnetopause. The low latitude boundary layer (LLBL) shows strong dawn-dusk asymmetry and constitutes a large proportion of the magnetosphere inside the magnetopause. The LLBL exhibits similar features in accordance with the MESSENGER's first flyby data. We discussed the formation process of the LLBL in detail and attempted to compare with the earth case with respect to the size and the existence of an ionosphere.

NEO Family Identification Associated with Earth Impacted Asteroid 2008 TC3

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ABSTRACT

The asteroid 2008 TC3 was discovered by the Catlina Sky Survey's 1.5-m telescope at Mount Lemmon, Arizona on October 6 06:39-07:23 UT (2008), that appeared to be on a collision course with Earth. Before the impact, about 570 observations from 26 observatories worldwide had captured. The atmospheric entry occurred on October 7 at 2:46 UT over northern Sudan, just 20 hours after it was first discovered. Desert search was set out by Jenniskens and Shaddado in December 2008. About 280 fragments weighting a total of 4 kg were recovered on the Nubiant Desert. This was the first recovered meteorite which orbital elements were determined accurately (1-sigma of semi-major axis = 8.74e-06 AU). The meteorite indicated achondrite, a polymict ureilite, anomalous in its class. The combined asteroid and meteorite reflectance spectra belonged to a F-class asteroids. The light curve of 2008 TC3 oscillated with an amplitude of 1.02 mag at main periods of 49.03 s and 96.99 s, that suggested a non-principal axis rotation. These tumbling motion and the estimated diameter 4.1m are implying the dumping time scale is 30,000 ± 10,000 yrs for 49 s. 2008 TC3 was most likely to be a break-up fragment. However, the catastrophic collision probability for Near Earth Objects (NEOs) is dramatically smaller than that of Main Belt asteroids due to much lower space density. So the origin and evolution of NEO

family is not known so far. In order to identify association of fragmented bodies, 6200 NEOs were examined by D-criterion. Meanwhile, the coincidental probability estimation was done using 10,000 synthetic Earth impactors. 4 probable bodies and 13 candidates were identified as 2008 TC3's association. Backward integrations (40,000 years) of these association and clones with the time step of 0.5 days were performed to estimate the close encounter with 2008 TC3.

Can a Planet Shine a Star?

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ABSTRACT

We investigate the thermal response of the atmosphere of a solar-type star to an electron beam injected from a hot Jupiter by performing a 1-dimensional magnetohydrodynamic simulation with non-linear wave dissipation, radiative cooling, and thermal conduction. In our work, the stellar atmosphere is modeled as a 1-D open flux tube expanding super-radially from the stellar photosphere to the planet. An electron beam is assumed to be generated from the reconnection site of the planet's magnetosphere. The effects of the electron beam are then implemented in our simulation as dissipation of the beam momentum and energy at the base of the corona where the Coulomb collisions become effective. When the average stellar field at the photosphere is about a few to 10 Gauss, a warm region forms in the chromosphere. The total luminosity of the beam-induced chromospheric radiation is estimated.

15 GHz VLBI Detection of the HST-1 Feature in the M87 Jet

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ABSTRACT

A bright feature 100 pc away from the core in the powerful jet of M 87 shows mysterious properties. Earlier radio, optical and X-ray observations have shown that this feature, labelled HST-1, is superluminal, and is possibly connected with the TeV flare detected by HESS in 2005. To examine the possible blazar-like nature of HST-1, we analyzed 2 cm VLBA data from dedicated full-track observations and the 2 cm survey/MOJAVE VLBI monitoring programs observed from 2000 to 2008. Applying wide-field imaging techniques, the HST-1 region was imaged at milliarcsecond resolutions. Here we present the first 15 GHz VLBI detection of this feature and discuss the connection between our radio findings and the TeV detection.

Dust Properties in Metal-Poor Galaxies Observed by AKARI

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ABSTRACT

We report on basic far-infrared (FIR) properties of a sample of blue compact dwarf galaxies (BCDs) observed by AKARI/FIS. In general, BCDs have concentrated low-metallicity star-forming regions, which may be similar to those in primeval starbursts at high redshift. Thus, studies of FIR dust emission from BCDs are useful to obtain an insight into high-redshift dust properties. We measured the fluxes at the four FIS bands at 65 μm, 90 μm, 140 μm, and 160 μm. We find that the typical dust temperature of the BCD sample is systematically higher than that of normal spiral galaxies. This confirms the spatially concentrated star-forming activity in BCDs. Interestingly, there is a correlation between dust temperature and dust-to-gas ratio, which indicates that dust-poor galaxies tend to host compact and intense star-forming activities. We have also found that there is a large variety in star formation timescale. A natural interpretation of this large variety can be provided by intermittent star formation activity. We finally show the relation between dust-to-gas ratio and metallicity in the context of chemical evolution

scenario.

Cosmic Rays in Active Galaxies

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ABSTRACT

We investigate the cosmic-ray abundance of several active galaxies by studying the thermal properties of molecular clouds in these galaxies. Recent studies of some nearby active galaxies have discovered high-temperature molecular clouds in the inner regions of these galaxies. The origin of these high-temperature molecular clouds in is unclear, but it seems to be a general phenomenon in the central region of active galaxies. We suggest that these molecular clouds are mainly heated by enhanced cosmic rays in these active galaxies. Considering the star formation rates in these active galaxies, we find that the cosmic rays from supernova events can not account for the heating. We suggest that the cosmic rays might come from the central AGNs of these active galaxies.

The Current Status of the ALMA-Taiwan Project

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ABSTRACT

Since 2005, Taiwan has participated in the Atacama Large Millimeter/Submillimeter Array (ALMA) project, the largest ground based astronomical project ever carried out. The array is now under construction in the Chajnantor area in the Atacama desert in northern Chile. The ALMA project has three major international partners: North America (NA), Europe (EU), and Japan. The NA and EU partners are responsible for the construction of the 12 m Array (ALMA-baseline project), while Japan is responsible for the construction of the Atacama Compact Array (ACA; ALMA-Japan project). Taiwan has been participating the ALMA Project through ALMA-Japan and ALMA-NA. ALMA will be completed in 2012, and its expected lifetime is at least 50 years. The ALMA construction is now getting into the exciting phase: as of April 2009, there are thirteen 12 m antennas (nine from ALMA-NA and four from ALMA-J) are under construction and testing at the ALMA Operation Support Facility (OSF) in Chile. Two front-ends were also delivered to OSF, and using these two front-ends the first fringe was successfully obtained with Mars. One of these two front-ends was assembled and tested at East Asia Front-End Integration Center (EA FEIC) that ALMA-Taiwan, in collaboration with Aeronautical Research Lab. (ARL), has established in Taiwan. EA FEIC will continue to deliver front-ends to OSF. In addition to EA FEIC, ALMA-Taiwan has started working on the development of the Alternate Laser Synthesizer (ALS) to provide the reference signal with better phase stability. In my presentation, I will show the latest status of the ALMA project, with an emphasis on activities ALMA-Taiwan has been carrying out.

Measurements of Absorption, Emissivity Reduction, and Local Suppression of Solar Acoustic Waves in Sunspots With Different Frequencies and Phase Velocities

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ABSTRACT

The power of solar acoustic waves in magnetic regions is lower relative to the quiet Sun. Absorption, emissivity reduction, and local suppression of acoustic waves contribute to the observed power reduction in magnetic regions. In previous works, we have proposed a model for the energy budget of acoustic waves propagating through a sunspot in terms of the coefficients of absorption, emissivity reduction, and local suppression of the sunspot. Using the property that the waves emitted along the wave path between two points have no correlation with the signal at the starting point, we can separate the effects of these three mechanisms. Applying this method to helioseismic data filtered with direction and phase-velocity filters, we measured the fraction of the contribution of each mechanism to the power deficit in the umbra of the leading sunspot of NOAA 9057. Here we apply the same method to the wave packets of different frequencies and phase velocities. The dependence of three coefficients on frequency and phase velocity

could provide more information on the interaction between the acoustic waves and the sunspot, and the understanding of mechanisms causing the power reduction in magnetic regions.

Observations and Theory of Solar Flares and Coronal Mass Ejections

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ABSTRACT

Solar flares and coronal mass ejections are the most powerful energy release process in the solar system. They have been observed by using soft and hard X-rays, EUV, visible light, sub millimeter, millimeter and microwaves. I will present observations of flares and associated coronal mass ejections and the theory of magnetic reconnection to explain the observed results.

Asteroseismology of Magnetars and QPOs in X-ray Outburst of SGR 1806-20 and SGR 1900+14

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ABSTRACT

A brief outline is given of our theoretical investigations on asteroseismology of pulsars and magnetars in the light of recent discovery of quasi-periodic oscillations (QPOs) of outburst X-ray emission of SGR 1806-20 and SGR 1900+14. Emphasis is laid on physical interpretation of the detected QPOs as being produced by quake-induced non-radial torsional shear vibrations restored by forces elastic and magnetic field stresses.

Emissions from Pulsar Wind Zone

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ABSTRACT

Recent observations of the Crab pulsar indicate the emissions from the region close beyond the light cylinder but before the synchrotron nebula, so called pulsar wind zone. The emissions from the pulsar wind zone may be caused due to the energy conversion (e.g. magnetic reconnection) from the magnetic energy to the particles beyond the light cylinder. In this study, we investigate the emissions in optical to gamma ray energy bands from the pulsar wind zone with the synchrotron and inverse Compton emission process. For the dissipation model of the magnetic fields, we adopt a recent model of the magnetic reconnection. We compare the calculated spectra and the polarization properties with the recent observations.

Current Status of Lulin 2-m Telescope Construction Project

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ABSTRACT

The 2-m telescope is being constructed at Lulin observatory in Taiwan. The purpose of this telescope is to carry out immediate and intensive follow-up observations for newly discovered objects by Pan-STARRS PS1 sky survey to maximize the scientific outputs. The manufacture of the telescope is being done without technical problems. The polishing of the primary mirror is completed. About 90% of the telescope mount construction is finished, and we expect the shipping of the telescope system to Taiwan in summer 2009. The construction of the building at Lulin will be started soon. In parallel, we are also running the instrumentation program. Main targets for PS1 follow-up observations are (1) transient objects, such as gamma ray bursts, soft X-ray transients, and supernovae, and (2) moving objects, such as asteroids, comets, and trans-Neptunian objects. Those targets will be observed at Lulin observatory at

where the sky condition is not excellent as those in Hawaii or northern Chile and is often unstable. In order to execute accurate and efficient color measurements of transients and small solar system bodies, we develop a visible four-color simultaneous imager for the 2-m telescope. For the development of the instrument, a laboratory with the electronics workshop, clean room, optical bench, and dark room is being prepared. The consolidation of this laboratory is completed in 1-2 months. We report the current status of the Lulin 2-m telescope construction project.

Extremely Active Molecular Jets in L1448C

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ABSTRACT

The protostellar jet driven by L1448C was observed in the SiO J=8-7 and CO J=3-2 lines and 350 GHz dust continuum at ~1" resolution with the Submillimeter Array (SMA). A narrow jet from the northern source L1448C (N) was observed in the SiO and the high-velocity CO. The jet consists of a chain of emission knots with an inter-knot spacing of ~2" (500 AU) and a semi-periodic velocity variation. These knots are likely to be the internal bow shocks in the jet beam that were formed due to the periodic variation of the ejection velocity with a period of ~15-20 yr. It is found that the jet is extremely active with a mechanical luminosity of > 6 $L_{\odot}$, which is comparable to the bolometric luminosity of the central source (7.5 $L_{\odot}$). The high mass-loss rate of 10^{-5} $M_{\odot}$ yr^{-1} suggests that the mass and the age of the central star are 0.03-0.09 $M_{\odot}$ and (4-12)×10^{3} yr, respectively, implying that the central star is in the very early stage of protostellar evolution. The low-velocity CO emission delineates two V-shaped shells with a common apex at L1448C(N).The kinematics of these shells are reproduced by the model of wide opening angle wind. The co-existence of the highly-collimated jets and the wide-opening angle shells can be explained by the "unified *X*-wind model" in which highly-collimated jet components correspond to the on-axis density enhancement of the wide-opening angle wind.

SMA Observations of the UC HII Region G5.89-0.39

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ABSTRACT

We present observations of the CH3CN (12-11) emission at a resolution of ~2" toward the shell-like ultracompact HII region G5.89-0.39 with the Submillimeter Array. The integrated CH3CN emission reveals dense molecular gas with a cavity centered at the HII region G5.89-0.39 and exhibits dense and warm molecular gas in its periphery, consistent with the picture of a dust and molecular gas free cavity within the HII region. With the population diagram analysis, we estimate the dense gas temperature ranging from ~40 K to ~150 K. More importantly, we have for the first time resolved the temperature structure in this region. The gas temperature can be well scaled as $T \sim r^{-0.4}$, where r is the projected distance to Feldt's star, the exciting star of the HII region. The results therefore indicate that the majority energy to heat the observed dense gas is supplied by Feldt's star.

Investigation of Complex Organic Molecules in Orion KL

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ABSTRACT

Observing of interstellar molecules is an essential way to test the physical and chemical conditions in the interstellar medium (ISM). To date, not only simple molecular species were detected in the ISM but many complex organic molecules (COMs) have also been detected in star-forming regions. However, due to the complexity of organic chemistry in hot molecular cores (HMCs), the detailed processes and mechanisms of forming COMs are still unclear and remain to be determined. Hence we conducted the observations at 213 GHz using the Submillimeter Array (SMA) toward Orion KL, and we have detected a

number of COMs in this massive star-forming region. We found the spatial distribution of O-bearing molecules, such as $HCOOCH_3$, $(CH_3)_2O$ and $(CH_3)_2CO$, is not much different from that of N-bearing molecules (e.g. NH_2CHO, C_2H_3CN and C_2H_5CN) within the Orion KL HMC, with the two species overlapped spatially to each other. It indicates that the well-reported N/O chemical differentiation in earlier studies between the Hot Core and the Compact Ridge may not be as significant as previously thought. On the other hand, the spatial distribution of C_2H_5OH (ethanol) is similar to that of CH_3OH (methanol) and its isotopomers CH_2DOH and CH_3OD which suggests likely common forming paths between these two alcohols. In addition, the very broad line profiles of isolated, clean C_2H_5CN lines reveal a complicated velocity structure in the region which is crucial to our kinematic study of Orion KL.

A Panoramic View of Star Formation in the Milky Way

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ABSTRACT

A census of pre-main-sequence (PMS) stars in the Milky Way has been perform by using 2MASS point source catalog. Based on the color-color and color-magnitude criteria, More than twenty two thousand PMS star candidates are selected. The majority of the PMS star candidates are distributed along the Galactic plane, and star formation activities in first and forth quadrants are higher than those in second and third ones. Furthermore some of the PMS stars are clustered or grouped together to form star-forming regions. I have identified near two hundred star-forming regions which allows us to determine the scale height of the star-forming regions. This result will be compared with the scale heights of molecular clouds and open clusters.

A Comprehensive Census and Characterization of Galactic Open Clusters

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ABSTRACT

There are currently some thousands of catalogued open clusters (OCs) in the Milky Way, mostly within 1-2 kpc. This is to be compared with tens of thousands of such star systems predicted by Galactic models. Our pilot study to analyze the 2MASS point sources within Galactic latitude +/- 5 degrees resulted in more than a hundred uncharted OCs, some of which have been characterized by optical and infrared photometry. Here we present a comprehensive search for OCs with the Pan-STARRS database. We show how such an OC sample would serve as a probe to the structure and chemical evolution of the Milky Way Galaxy.

Posters / 壁報論文展示

Measurements of Absorption, Emissivity Reduction, and Local Suppression of Solar Acoustic Waves in Sunspots

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ABSTRACT

The power of solar acoustic waves in magnetic regions is lower relative to the quiet Sun. Absorption, emissivity reduction, and local suppression of acoustic waves contribute to the observed power reduction in magnetic regions. We propose a model for the energy budget of acoustic waves propagating through a sunspot in terms of the coefficients of absorption, emissivity reduction, and local suppression of the sunspot. Using the property that the waves emitted along the wave path between two points have no correlation with the signal at the starting point, we can separate the effects of these three mechanisms.

Applying this method to helioseismic data filtered with direction and phase-velocity filters, we measure the fraction of the contribution of each mechanism to the power deficit in the umbra of the leading sunspot of NOAA 9057. The contribution from absorption is 23.3 ± 1.3%, emissivity reduction 8.2 ± 1.4%, and local suppression 68.5 ± 1.5%, for a wave packet corresponding to a phase velocity of 6.98×10^{-5} rad s^{-1}.

A Statistical Study of CME-related Solar Active Regions

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ABSTRACT

Coronal mass ejection events (CMEs) characterized by the formation of magnetic clouds and plasma bubbles in the interplanetary space are closely related to the study of space weather. In order to investigate the statistical correlation of CMEs with the sizes and ages of corresponding active regions, we have performed a statistical study of the time evolution of a number of active regions with the production of at least one CME in 2005 when was close to the recently solar minimum(Oct 2008). The statistical study includes analysis of measurements from the MDI (Michelson Doppler Imager) and the CMEs catalogue from LASCO (Large Angle and Spectrometric Coronagraph experiment) on the SOHO spacecraft. We also use the Solar Region Summary (SRS) from the Space Weather Prediction Center (SWPC) of National Oceanic and Atmospheric Administration (NOAA) to trace the daily position of active regions. The preliminary results are: (1) The distribution of CME is relatively uniform over each active regions and (2) the amount of CME occurrence is proportional to the AR's lifetime.

Acoustic-Power Maps of Solar Active Regions with Direction Filters and Phase-Velocity Filters

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ABSTRACT

We study the properties of power maps of solar acoustic waves filtered with direction filters and phase-velocity filters. A direction filter is used to isolate acoustic waves propagating in a narrow range of directions. The acoustic-power map of the waves filtered with a direction filter shows extended reduced-power features behind magnetic regions with respect to the wave direction. A phase-velocity filter is further applied to isolate waves with similar wave paths. In the power maps of the waves filtered with both a direction filter and a phase-velocity filter, a reduced-power image of a sunspot appears behind the sunspot with respect to the wave direction. The distance between the sunspot and the secondary image is consistent with the one-skip travel distance of the wave packet associated with the phase-velocity filter. The waves filtered with direction and phase-velocity filters at the location of the secondary image could be used to probe the sunspot. In the quiet Sun, spatial fluctuations exist in any acoustic-power map. These fluctuations are mainly caused by interference among modes with the same frequency. The fluctuations are random with two properties: They change rapidly with time, and their magnitude decreases with the square root of the number of frames used in computing the acoustic-power map.

The Dynamical Evolution of Coronal Loops

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ABSTRACT

In the standard magnetic reconnection model of solar flare eruption, we already know that the energy source might come from the magnetic fields located below the photosphere. And the released energy converts into the kinetic and thermal energy of surrounding plasma which might fill up the whole loop. There could be two possible ways to heat the cool loops successfully: 1.the heating mechanism occurs as height as the corona and propagate directly into the original cool loop 2. the hot plasma fills up the loop from the footpoint in the chromosphere. And we want to know how these two ways apply during the lifetime of flare eruption which could be the compensation for the unknowing link in the standard model of flare. We now use the TRACE observation to reconstruct the possible time evolution of coronal loop

system during one flare event and also introduce the expansion factor r=Wmid/Wf and some geometric quantities (e.g. length ,width..) to outline the basic properties of loops. The primary result is that mean expansion factor is about 1.

Estimation of Reconnection Electric Field in Two-Ribbon Flares

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ABSTRACT

The magnetic reconnection in the corona is generally believed to be responsible for the energy release and particle acceleration in solar flares. In this study, the separations of two ribbons observed by Ha/EUV, as well as the HXR footpoint motions observed by RHESSI, are used as the chromospheric signatures of progressive reconnection. To determine the reconnection electric fields in a flare, we estimate the magnetic flux change rate in the areas of enhanced Ha/EUV intensity and HXR kernels at a flaring time. The spatial and temporal relationship between the reconnection electric fields and the HXR intensity will be addressed and discussed here.

Test Particle Simulations of Solar Wind Interaction with the Lunar Surface

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ABSTRACT

Due to the lack of an atmosphere and an intrinsic global magnetic field, the solar wind protons and other ions can impinge directly on the lunar surface leaving a void in the nightside wake region. At the same time, the lunar surface is subject to electrostatic charging effect by photoemission and solar wind plasma charging. The NASA Lunar Prospector spacecraft found that the dayside hemisphere of the Moon has a surface potential of about 20 V and the nightside hemisphere has negative potential (because of the absence of photoemission) of the order of -200 V to – 1 KV. The recent in-situ measurements by the lunar orbiting spacecraft, Chang'e-1 (CNSA) and Kaguya (JAXA), have shown the interesting phenomenon that solar wind protons near the terminator could be accelerated or decelerated which might be the consequence of the surface electrostatic field. We have performed test particle trajectory calculations to assess this surface electrostatic charging effect. In addition, we have also simulated the flux of solar wind protons reflected from the dayside lunar surface as reported by the Kaguya plasma science team. We will also discuss the problem of solar wind interaction with the magnetic anomalies on the lunar surface.

Spatial Distribution and Characteristics of Rampart Craters on Mars Using Multi-Spacecraft Observational Data

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ABSTRACT

Some Martian craters filled with water ice and CO_2 ice on their bottom at northern polar region (upper than 65°N). Areas of ice filled regions of craters change during seasons. One of the special types of impact craters are rampart craters which only exist on Mars. It is considered to indicate ice or liquid water buried beneath the surface of Mars at the time of impact. We use four instruments - HRSC (High Resolution Stereo Camera, Mars Express), MOC (Mars Orbiter Camera, Mars Global Surveyor), THEMIS (Thermal, Emission Imaging System, Mars Odyssey) and HiRISE (High Resolution Imaging Science Experiment, Mars Reconnaissance Orbiter) – in order to characterize the physical properties of ice-bottomed craters. We systematically investigate the relationships between morphology, crater diameter vs. ice cap diameter and depth of craters. These results show that craters which have ice caps inside the cavity happened at higher latitude and the depth of the ice-rich layer may be very shallow. The

presence of ice shows that there is much water-ice on and beneath the surface of the Martian polar region.

A Study of Global and Temporal Variabilities of Titan's Exosphere

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ABSTRACT

Since its SOI in July 2004, the Cassini spacecraft has made more then 50 encounters. The measurements by the INMS instrument have brought a wealth of new information on the chemical composition and vertical distributions of the N_2, CH_4, H_2 and the other gaseous species. Detailed analysis of the exospheric structure has led to the preliminary conclusion that the density distributions are time-variable. In this work, we will use the INMS data to investigate the range of variations for N_2, CH_4, H_2 and some other minor species at different positions and local times.

Deprojection of the Expanding Dust Coma of 2007 Outburst of Comet 17P/Holmes

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ABSTRACT

Immediately after the report of the sudden outburst of comet 17P/Holmes on October 23, 2007, an optical observational program was established at Lulin Observatory to provide comprehensive coverage of the time evolution of the expanding coma of this unique comet. Wide-band BVRI filter images were obtained from the start to the early January in 2008. A description of the photometric observations has been submitted for publication (Z.Y. Lin et al., Astron. Journal, 2009, submitted). In this work, we will report on the current effort in developing an axially symmetric three-dimensional model of the expanding dust coma by numerical deprojection. This treatment will help us to visualize and to trace the motion of the dust particles emitted from the short-term outburst and the persistent presence of dust jets on one side of the comet nucleus. The implication on the physical origin of this outburst will be discussed.

Spectral Line Observations of Comet 17P/Holmes

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ABSTRACT

Study of cometary chemical compositions through observations of different molecular lines can give us valuable and useful information of the protosolar nebula and perhaps even on the origin of life. The unusual Comet 17P/Holmes (hereafter Comet/17P), which is a short-period Jupiter-family comet, underwent an apparent gas outburst on 2007 October 24, hence the sudden dramatic increase of its brightness, became a naked-eye object in two days. We used the Submillimeter Telescope (SMT) and the Kitt Peak 12m telescope (KP12M) of the Arizona Radio Observatory (ARO) to observe the comet in 2007 November 9–12. We successfully detected HCN J= 1–0 and 3–2 lines, and a group of five CH_3OH (methanol) lines of the J = 5–4 in Comet/17P. c-C_3H_2 (cyclopropenylidene) of J = 7–6 transition, HDO (water) of $J = 2_{1,1}–2_{1,2}$ transition and HDCO (formaldehyde) of $J = 2_{1,1}–2_{1,0}$ transition were detected marginally.

Dynamical Simulation of Comet C/2007 N3(Lulin)'s Anti-tail

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（葉永烜）
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ABSTRACT

Comet C/2007 N3 (Lulin) was discovered by Lulin observatory. This new comet from the Oort cloud has a retrograde orbit with inclination i=178°. Such orbital configuration permitted the anti-tail which was composed of large dust particles to be observed prominently by Earth observers. We have developed a numerical model to simulate the time-dependent ejection of dust particles of different sizes from a cometary nucleus and the dynamical evolution of the dust tail. The synthetic dust tail of Comet C/2007 N3 (Lulin) will be compared with the observations.

c-C_3H_2 in Comet C/2007 N3 (Lulin)

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ABSTRACT

The greenish bright comet C/2007 N3 (Lulin), with a water production rate of ~10^{29} mol s^{-1}, passed the perigee at a geocentric distance of about 0.4 AU. Thus, we had a perfect chance to study the chemical composition of Comet Lulin via single-dish spectral line observations while the comet was orbiting near its perihelion. The observations were conducted for a total of 9 days between 2009 February 11 and March 05 using the Kitt Peak 12M telescope and the Submillimeter Telescope (SMT), both of the Arizona Radio Observatory, in the 1.3-, 2- and 3-mm bands. Molecules including CS, SO, SO_2, HCN, OCS, H_2CO and CH_3OH were observed. In addition, a very important result is that we detected three *c*-C_3H_2 lines, the organic ring cyclopropenylidene; this is the first firm detection ever of this molecule in a comet to date, and it has significant implications for the cometary chemistry. *c*-C_3H_2 may be produced in the cometary coma by the photolysis of aromatic compounds and serve as a surrogate of cometary aromatic material.

Single-Dish Observations of Comet 73P/Schwassmann-Wachmann 3 at 1.3 and 3mm

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ABSTRACT

Comet 73P/Schwassmann-Wachmann 3 (hereafter Comet 73P) is a short period comet (5.4 years) which split into many fragments during its 1995 passage. In its 2006 perihelion, Comet 73P passed the Earth at the closest of ~0.08 AU while it was ~1.05 AU away from the Sun. This proximity made a perfect opportunity to observe the molecular gases released directly from the cometary nucleus toward the two largest Fragments, B and C, with single-dish radio telescopes. At 0.08 AU, for example, a 30” beam corresponds to a linear scale of ~1700 km merely. We therefore utilized Kitt Peak 12m telescope (KP12M) and the Submillimeter Telescope (SMT) of Arizona Radio Observatory to observe Comet 73P at 1.3 and 3mm. The HCN *J*=3–2 line at 265.886 GHz and *J*=1–0 transition at 88.631 GHz were clearly detected in Fragment C. H_2CO $2_{1,1}$–$1_{1,0}$ transition at 150.498 GHz was marginally detected toward Fragment C with a double-peak line profile implying the expansion of the inner coma. However, deuterated species of formaldehyde, HDCO, and hydrogen cyanide, DCN, were searched with no success.

A Study of the Diffraction by Trans-Neptunian Objects of Irregular Shape

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ABSTRACT

Small trans-Neptunian objects (TNOs), which are about the size of typical comets, were simply

regarded to be spherical ones in most of the previous studies. Though, small TNOs are generally believed to be irregular in shape. A traditional diffraction calculation might include a two-dimensional integration over the TNO disc. It could be very time-consuming to obtain a systematic result when a wide-band spectrum and the non-trivial size of a background source are considered. Here, we present a different approach using the theory of boundary diffraction waves so that a statistical result can be obtained in a fairly reasonable computing time over several different irregular shapes. Comparing to the results derived with the spherical assumption, our work provides a more realistic insight into the general properties of the diffraction effect in a serendipitous occultation survey of TNOs. It can be integrated as part of the TAOS (Taiwan-America Occultation Survey) simulator in the near future.

The Search for Trans-Neptunian Binaries in the Pan-STARRS 1 Project

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ABSTRACT

During the accretion and collisional evolution of the solar system, dynamical interaction of icy planetesimals and planetoids in the outer solar system could have led to the formation of satellite systems like those of the Pluto-Charon system, Eris and Haumea. Formation of binary systems among the Trans-Neptunian Objects (TNOs) was also possible via three-body capture and other mechanisms. The formation efficiencies of different orbital types of TNO binaries (or TNBs) depend sensitively on the number density of planetesimals at that time. An in-depth study and understanding of the TNBs are therefore fundamental to planetary science. In the present population of about 1000 detected TNOs, there are 50 TNBs.. Most of them were discovered by HST because of its superb angular resolution which can resolve the two components in a wide-binary system. Ground-based telescopes are limited by the seeing condition and angular resolutions so that TNB candidates could be detected only by imaging processing and profile fitting algorithms. Following the procedure we have developed in our previous analysis of data from the Canada-France Ecliptic Plane Surveys (CFEPS), we are able to produce numerical simulations to calculate the TNB detection efficiency in the Pan-STARRS 1 (PS1) project. Our current estimate is that about 20 wide binaries with separation > 1 aresec will be found by PS1. In comparison, the total number of wide TNBs discovered so far is less than 10. The addition of this new group of TNBs from PS1 will bring important insights to their orbital statistics and the formation history of the Solar System.

Jovian Trojans Detection Simulation for Pan-STARRS

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ABSTRACT

The dynamical configuration makes Jovian Trojans almost isolated from other asteroid populations. Despite of rarely interacting with Hildas, Jupiter comet family and Centaurs, their collisional evolution is mainly driven by intrapopulation interact. Thus, Jovian Trojans are believed to preserve the information, no matter dynamical or physical properties, of early solar system history. (Marzari 1996, 1997) The asymmetry in population (Yoshida 2008) and color (Roig 2008) of Jovian Trojans L4, L5 swarm was reported recently. Also a possible trend that the higher inclination objects is more red was found by Szabo et al. (2007) with SDSS MOC data. However, Yang & Jewitt (2008) concluded no such kind of trend as a result of CFHT data of ~80 high inclination Jovian Trojans. Moreover, the phase angle curve of Jovian Trojans seems to be more similar with gray Centaurs (Schaefer 2008) that maybe a hint of Jovian Trojans' origin. So far no water features was observed on Jovian Trojans, but they, locate beyond the snow-line, are expected to have ice or hydrated minerals (Yang 2007). These kinds of information can provide us some hints of how Jovian Trojans was formed or where they come from. If Jovian Trojans were formed in the outer solar system region and scattered inward during the planet migration, then their properties should be more similar to the KBOs (Morbidelli et al. 2005). If they were formed in the current location, then they should differ from the small objects in outer solar system (Marzari & Scholl 1998). Pan-STARRS is potential to increase the amount of Jovian Trojans with size lager 2km dramatically. In order to study the performance of MOPS, we purpose a serious detection simulations.

HAYABUSA Re-entry Capsule Observing Campaign

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ABSTRACT

HAYABUSA, which was launched on May 9, 2003, achieved its goal of arriving at the Itokawa asteroid and performing scientific observations. As a result, its mission was featured in the scientific magazine "Science" as a first Japanese mission to illustrate various new findings about the asteroid including its gravity and surface conditions. HAYABUSA is now under preparations for its return trip to the Earth in 2010. The capsule was covered with an ablative heat shield made of carbon-carbon. The ablation of the carbon from the heat shield would carry heat away from the surface and help prevent the heat wave from penetrating to the asteroidal sample. The high entry speed, ~12km/s, and the ablative heat shield will make this reentry the large artificial meteor. The return trajectory of the HAYABUSA capsule is very similar to that of Near Earth Asteroids (NEAs) and meteoroids. Spectroscopy of the capsule will provide us with golden opportunities to conduct chemical and physical process of artificial fireball in the upper atmosphere. Here, we will present our observing campaign plan which will be held on the Woomera desert in Australia in mid-June 2010.

On the Atmospheric Thermal Bulge of a Super-Earth

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ABSTRACT

Super-earths are rocky exoplanets of 5-10 earth masses. Assuming that a super-earth has a dense hydrogen-rich atmosphere, we perform a linear analysis to investigate the properties of the atmospheric thermal bulge excited by stellar irradiation. The torque acting on the spin of the planet due to the atmospheric bulge is estimated and is compared to that due to the gravitational tidal bulge.

Why Are There So Few Hot Jupiters?

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ABSTRACT

It has been shown from the current observational data that there is a mass-semimajor axis correlation for hot Jupiters. This correlation is related to the absence of less massive giant planets (<1 Jupiter mass) within ~ 0.03AU from their parent stars. We employ numerical simulations to model the orbital evolution of a planet inside the magnetospheric cavity of a proto-planetary disk and compare the results with the observational data. Our numerical result shows that while a massive planet can cause effective stellar tides accompanied with a magnetic torque on its star and then undergoes an orbit decay, a less massive planet either survives or destructs at the 2:1 resonance with the inner edge of the disk depending on the eccentricity. We suggest that the tidal and magnetic interactions between young hot Jupiters and their parent proto-stars can explain the mass-semimajor axis correlation for hot Jupiters.

The First Submillimeter Interferometric Imaging of the Molecular Outflow in L1551 NE

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ABSTRACT

L1551 NE is the second brightest source in the L1551 star-forming region, sits only 2' northeast to the brightest source L1551 IRS5. It is a binary system, with two components separated only 0.5" with each other. Although L1551 NE is classified as a Class 0 protostar, which normally drive energetic molecular outflows, the molecular outflow from L1551 NE is not yet confirmed. Here we present the first

unambiguous detection of molecular outflow associated with L1551 NE. Using SMA (Submillimeter Array), we imaged the CO(3-2) line emission, which traces more intense and warmer gas, at a subarcsecond angular resolution toward the vicinity of L1551 NE. The CO(3-2) line emission appears a clear bipolar structure, with its redshifted lobe in northeast and blueshifted lobe in southwest. This orientation agrees with that of HH objects and infrared cometary nebulae, suggesting the CO gas is molecular outflow powered by L1551 NE. The CO outflow reveals two basic properties of L1551 NE: 1) We found the counterpart of the infrared reflection nebula associated with western protostar, however, no counterpart of collimated [FeII] jet of eastern protostar. These results indicate the western protostar is more evolved, has launched outflow first and cleared ambient gas, thus no gas can be entrained by the later powering source. 2) L1551 NE has typical dynamical age and momentum supply rate of a Class 0 protostar, however the outflow mass is much smaller, indicating the lower density of ambient region. The lower density is probably due to impact from L1551 IRS5, which drives a prominent outflow, passed through L1551 NE region and has blown the gas envelope off.

Subarcsecond-resolution Spectral Observations of Protostellar Source IRAS 16293-2422

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ABSTRACT

To study the organic inventory in class 0 sources, we conducted 344-/354-GHz observations of IRAS 16293-2422 at 850μm using the Submillimeter Array (SMA) with an angular resolution of 0.9”×0.5”. IRAS 16293-2422, located in the ρ Ophiuchus cloud at a distance ~ 160 pc from the Earth, is a low-mass protobinary system that contains two continuum sources I16293A and I16293B with separated by 5.2”. Our high angular-resolution continuum images resolved I16293A into two thermal dust components, but I16293B remains unresolved. Also detected are organic molecules including *c*-C_3H_2, HCN, C_2H_5CN, $H_2{}^{13}CO$, CH_3OH, $^{13}CH_3OH$, CH_3OCH_3, HCOOH, CH_3OCHO and H_2CS in both I16293A and I16293B.In addition, molecular species such as SO, SO_2, $SO^{18}O$, $C^{34}S$, and SiO were also observed. The existence of rich organics in IRAS 16293-2422 is important for astrochemistry study and also has significant implication in astrobiology. Rich organic molecules have been found in compact hot molecular cores of massive star-forming regions; our findings suggest similar formation mechanisms of organic molecules may exist between low- and high-mass star-forming regions.

Outflow - Core Interaction in Barnard 1

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ABSTRACT

In order to study how the outflows from protostars influence the physical and chemical conditions of the parent molecular cloud, we have studied the Barnard 1 (B1) main core, which harbors three class 0 and three class I sources, in the CO, CH_3OH, and SiO lines using the NRO 45 m telescope. We have identified two CO outflows in this region; one is an elongated outflow from a class 0 protostar, B1-c, and the other is a rather compact bipolar outflow from a class I protostar,B1-a. In the western lobe of the B1-c outflow, both SiO and CH_3OH lines show broad redshifted wings having the terminal velocities of 25 km/s and 13 km/s, respectively. The abundance enhancement of SiO and CH_3OH molecules in the outflows reaches 10^4 and 10^2, respectively, compared with those in quiescent clouds. It is likely that the shocks caused by the interaction between outflow and ambient gas enhanced the abundance of the molecules in the gas phase. The total outflow energy input rate ($> 5.0 \times 10^{-3}$ $L_\odot$) is comparable to the energy loss rate (8.8×10^{-3} $L_\odot$)) through turbulence decay in the B1 main core, which indicates that the outflows can provide enough energy to maintain the turbulence in this region.

Millimeter Interferometric Observations of Holoea in M36

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ABSTRACT

The source nicknamed *Holoea* is a Young Stellar Object associated with IRAS 05327+3404. It was discovered in optical observations of the Galactic open cluster M36 in Auriga, although it is probably not associated with M36 and may be a distant member of the nearby S235 region. *Holoea* drives an unusually powerful ionized outflow, seen in both CO 2-1 and optical spectra, and it was classified as a transitionary object between the Class I, because of a rising SED and a molecular bipolar outflow, and Class II YSOs, because it has a visible central star and an ionized outflow. With an optical spectral type of K2III, Holoea is probably an FU Orionis star similar to L1551 IRS 5. The SED also shows the presence of large amounts of circumstellar material, which according to optical and near-IR observations of the reflection nebula seems to be arranged in a disk with a relatively wide central hole of ~ 33 degree opening angle. The ionized flow, the CO outflow and the hole are all roughly aligned. We studied Holea at high-angular resolution with the BIMA array in the 3-mm band, through observations of the CO (1-0), HCO^+ (1-0) and HCN (1-0) molecular rotational transitions centered at the position of the YSO. The interferometric observations we present show a complex velocity structure in CO, with several V-shaped red-shifted velocity components, and a blue-shifted ring-like structure. Based on our high-resolution molecular data, Holoea is very likely a binary system, with one component being the K2III star, and another component, an optically invisible protostar. The molecular bipolar outflows observed were thus believed to be originated from this protostellar source.

Observing Simulations of Atacama Large Millimeter and Submillimeter Array (ALMA)

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ASIAA

ABSTRACT

In this poster, we will present results of our simulations of ALMA observations. ALMA (Atacama Large Millimeter and submillimeter Array) is the next-generation largest radio telescope in the world, and consists of two main instruments; one is an interferometric array with 64 12-m antennas (12-m array), and the other so-called Atacama Compact Array (ACA). ACA is a Japanese and Taiwanese contribution to the ALMA project and consists of twelve 7-m antennas as an interferometric array and four 12-m antennas as Single-Dish telescopes. With a set of theoretically-predicted model images of protoplanetary disks where planetary systems are expected to form, we have performed ALMA observing simulations to find the most optimum observing method of ALMA and to assess the scientific performance of ALMA in a quantitative way. We have confirmed that inclusion of ACA drastically improves the imaging quality of ALMA observations. Currently we are deriving physical properties, such as densities and temperatures, of the protoplanetary disks from the simulated images, and comparing them to those of the "real" values, in order to assess how well ALMA observations reproduce "real" astrophysics. We will also report these results in the poster.

Poster Winner

The Young Stellar Object Populations in the Taurus Molecular Cloud

Tien-Hao Hsieh; Shih-Ping Lai
NTHU

ABSTRACT

We perform a census of the young stellar object (YSO) populations in the Taurus molecular cloud, using the combined data (1.25-70um) from 2MASS and the Taurus Spitzer Legacy Project. We first exclude stars and galaxies from the combined point source catalog with the standard procedure of the From-Molecular-Cores-to-Planetary-Disk (c2d) Spitzer Legacy Project (Harvey et al. 2007); stars are selected from the SED fitting and galaxies are selected from several color-color criteria. The remaining 168 sources in the point source catalog are YSO candidates. These YSO candidates are classified into

Class 0/I, II, and III according to their slope from K to MIPS1 band in the SEDs, which is close to Lada's original definition. We further separate Class 0 and Class I sources with a modified bolometric temperature. Our results show that (1) the YSO number density in Taurus is about one order of the magnitude lower than the YSO density in Perseus, Serpens and Ophiuchus, and (2) the percentage of the early stage YSOs (Class 0 and Class I) in Taurus is higher than that in other three clouds. These two features lead to a natural explanation that the Taurus Molecular Cloud is in a very early stage of star formation when the overall star formation rate is still low.

Organic Molecular Lines Detected in IRS 46 with the SMT

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ABSTRACT

Among more than 100 Class I and II sources searched in the Spitzer c2d legacy program, it was the first YSO discovered containing gaseous organic molecules C_2H_2 and HCN. IRS 46 is a low-mass Class I young stellar object (YSO) with an edge-on disk. Our study of the molecular inventory of IRS 46 is important for understanding the chemical evolution of low-mass YSOs and it will give us some hints on the organic molecular reservoir of our Solar System. Similar to hot molecular cores in massive star-forming regions, a few low-mass Class 0 YSOs with hot corinos have rich organic chemistry, probably due to grain-surface chemistry followed by gas phase reactions when icy mantles evaporate. Following these thoughts, we observed IRS 46 with the Submillimeter Telescope (SMT). We have successfully detected organic molecules H_2CO and CH_3OH. The excitation temperature derived from rotation diagram method is 227 K and the column density is 1.6×10^{13} cm^{-2}. Moreover, several strong terrestrial ozone (O_3) lines in absorption appeared in our IRS 46 spectra.

Submillimeter High Resolution Spectral-Line Observations of Orion KL

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[3] Astrochemistry Laboratory & Center for Astrobiology, Solar System Exploration Division, NASA Goddard Space Flight Center, Greenbelt, USA

ABSTRACT

Orion KL is one of the primary targets for the study of massive star formation in our galaxy due to its proximity (~ 450 pc). Especially, hot-core chemistry in Orion Hot Core and Compact Ridge therein reveals the nitrogen/oxygen dichotomy which has been the focus of astrochemistry study in the past few decades. Several chemical models, based on single-dish spectral line surveys mainly, were proposed in the hope to uncover the mystery of hot-core chemistry; however, the detailed picture remains unclear because of lacking high-resolution observations. Therefore arcsec-resolution SMA observations of the Orion KL hot molecular core at 331 and 341 GHz were conducted, including the mapping of the spectral emission of CH_3CN, C_2H_3CN, C_2H5CN, CH_3OH and $HCOOCH_3$ at multi-transitions. With the "population diagram" analysis, the fine distribution of kinetic temperature in the Orion KL region was derived together with the small-scale (< 500 AU) variations of chemical abundances of different molecular species. In addition, the clumpy nature of the gas cloud was also unveiled both spatially and spectrally. Our high angular-resolution SMA results of Orion KL will also be crucial for future chemical modeling of massive stare forming regions.

Search for High Proper Motion Objects in the CFHTLS Deep Fields

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ABSTRACT

The results of searching for high proper motion objects in the Canada-France-Hawaii Telescope Legacy Survey (CFHTLS) are presented. By detecting moving objects in the halo, the early stages of formation of the Galaxy can be investigated. Cool halo white dwarfs have evolved from a very early era of star formation in the Galactic halo and their unique blue colours brought on by collision induced absorption makes them easily recognizable. The CFHTLS Deep Survey covers 4 square degrees in 5 filters (u*,g',r',i',and z') and extends over a three-year baseline. Proper motion selection is used to distinguish cool high velocity white dwarfs from distant objects with similar blue colours such as compact faint galaxies and quasars. In this survey, 79 white dwarf candidates have been discovered on the basis of proper motion and colours brighter than g' = 24 and with ~35 mas astrometric accuracy. The coolest white dwarf we found is ~3250 K, however from its estimated velocity, it appears to be located in the disk.

Dust Emission and Spectral Characteristic of Classical Be Stars with Strong Infrared Excess

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ABSTRACT

Classical Be stars are B-type main sequence stars with one or more Balmer lines in emission, characterized by their rotational velocity (up to ~ 300 km/s), and circumstellar gas distributed in shell-, disk- or ring-like configuration. Classical Be stars also are associated with infrared excess attributed to free-free emission from ionized gas. A few with exceptionally large infrared excess, namely with J-H, and H-K both greater than 0.6 mag, however, must be accounted for by thermal emission from circumstellar dust which is condensed out in the flattened, expanding envelope as these fast-rotating stars evolve to the giant phase. This thesis calculates the extent plasma free-free emission can contribute to the near-infrared excess observed in the JHK color-color diagram and in the spectral energy distribution seen in the classical Be stars. We analyzed spectra from SMART 1.5m telescope and made detailed studies of 6 Be stars that show large JHK excess.

Point-Symmetric High-Velocity CO in Planetary Nebula NGC 6302

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ABSTRACT

The origin of the rich variety of morphologies observed in planetary nebulae (PNe) is one of the major unsolved problems in stellar evolution. We need to have a clear picture of the mass distribution in PNe to further understand the physical mechanism for the shaping of the nebulae. While the distribution of the ionized gas (through optical and radio imaging) is well determined, the distribution of the neutral gas is still undefined. The spatial distribution of CO J=3-2 emission shows, in addition to the well-known central torus, two emission peaks, blue and red shifted by ~ 30 km/s relative to the systemic velocity, located ~ 30" to the east and ~ 60" to the west from the center. Considering the inclination effect and the opening angle of the conical shell of outflows, we estimate actual velocity shifts are between ± 32.8 km/s and ± 115.9 km/s.

CRL618 as a Target to Study the Proto-Planetary Nebulae

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ABSTRACT

Collimated fast winds (CFWs) have been proposed to operate during the post-AGB evolutionary

phase (and even earlier during the late AGB phase), responsible for the shaping of pre-planetary nebulae (PPNs) and young planetary nebulae (PNs). This paper is a follow-up to our previous study of CFW models for the well-studied PPN CRL 618. Previously, we compared our CFW models with optical observations of CRL 618 in atomic and ionic lines and found that a CFW with a small opening angle can readily reproduce the highly collimated shape of the northwestern (W1) lobe of CRL 618 and the bow-like structure seen at its tip. In this paper, we compare our CFW models with recent observations of CRL 618 in CO J=2-1, J=6-5, and H_2 1-0 S(1). In our models, limb-brightened shell structures are seen in CO and H_2 at low velocity arising from the shocked AGB wind in the shell, and can be identified as the (low velocity) LV components in the observations. However, the shell structure in CO J=2-1 is significantly less extended than that seen in the observations. None of our models can properly reproduce the observed high-velocity (HV) molecular emission near the source along the body of the lobe. In order to reproduce the HV molecular emission in CRL 618, the CFW is required to have a different structure. One possible CFW structure is the cylindrical jet, with the fast wind material confined to a small cross section and collimated to the same direction along the outflow axis.

Speckle Observation of Binary Stars at NTNU

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ABSTRACT

The binary image will be distorted by atmosphere turbulence, and the angular separation of binary could be determined with speckle interferometry technology. The binary program with speckle interferometry at NTNU was set up since 2002. Now, the DMK 31AF03 CCD of the Image Source Company is used for our binary program equipped at C14 at NTNU campus. There are 18 binaries are chosen for our 2009 program, and the parameters of 12 binaries are determined.

Identification of Variable Stars in the TAOS Database

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ABSTRACT

The huge TAOS database is useful not only for detection of possible stellar occultation by Kuiper-belt objects, but also for stellar variability studies. Here we report the use of the TAOS database to search for uncharted variable stars. Stars which vary their brightness, periodical or otherwise, on time scales from a few seconds to hundreds of days, can be identified. We present our analysis of the star field no. 60, centered at RA=04h47m59.5s, Dec=+20°46' with a field of view of 1.7 degree on one side, which has been observed at 34 epochs. Of the 873 stars between 8 to 13.5 mag that have sufficient signal to noise for variability analysis, a total of 60 candidate variables have been found.

A Long-term Variability of CY Aqr

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ABSTRACT

3 new CCD photometric times of maximum light of the SX Phoenicis variable CY Aqr are combined with the times of maximum light listed in the literature, and a new ephemeris is determined from O-C diagram. The effect of light-travel time with eccentricity, e ~ 0.7, in a binary orbit is reasonably fitting the residuals of O-C diagram.

Long-term Modulation Period Changes in Low Mass X-ray Binary 4U 1820-30

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IANCU

ABSTRACT

We present our analysis result for the long-term variability of X-ray binary source 4U1820-30 using

the data from X-ray sky monitoring programs, including All-Sky Monitor (ASM) on *Rossi X-ray Timing Explorer* (RXTE), *Swift* Burst Alert Telescope (BAT), and Proportional Counter Array (PCA) data from RXTE galactic center observation program. A ~170*d* periodicity, agrees with the one proposed by Chou & Grindlay (2001), can be significant detected in the entire (from 1996 to 2008, ~13 years) *RXTE*/ASM light curve with Lomb-Scargle power spectrum, but this period likely shifts to ~167*d* from the power spectra of *Swift*/BAT, *RXTE*/PCA and ASM data observed after 2005. These light curves were then folded with the ephemeris proposed by Chou & Grindlay (2001) and a clear ~ 0.2 phase shift can be detected. The ~170*d* period phase evolution of *RXTE*/ASM light curve, derived from the cross-correlating with its mean modulation profile, exhibits apparent negative drift after 2004, which is consistent with the period detected by power spectra. In addition, evolution of phase derived from the intensity minima as fiducial points shows that period changed to $P = 164.7 \pm 1.2$ days after 2004. A quadratic fitting for the phase evolution gave a clear period derivative $\dot{P} = (-2.0 \pm 0.5) \times 10^{-3}$ from the 1996-2008 *RXTE*/ASM observation. All above evidences imply that the period of ~170 *d* modulation of 4U1820-30 is not as stable as that proposed by Chou & Grindlay (2001) and unlikely caused by the existence of third companion (i.e. triple model). In addition, we also attempted to confirm this period change with dynamic power spectrum. Although such period change is hardly seen, we found the power of ~170*d* period became weaker, as well as two more periodic modulations with higher frequencies appear, during *TJD11000~12500*. This fact can explain the abnormal phase behavior, which is highly likely due to the enhancements of secondary minima, during that period.

Long-term X-Ray Monitoring of Holmberg IX X-1 (M81 X-9) and NGC 5408 X-1 with Swift

Tzu-Ching Yen; Yi-Jung Yang; Albert Kong
National Tsing Hua University

ABSTRACT

We analyze data from Swift XRT observations of two ultraluminous X-ray sources (ULXs), Holmberg IX X-1 (M81 X-9) and NGC5408 X-1. It is well known that both ULXs have a cool accretion disk with a power-law component, an indication of an intermediate-mass black hole. Due to the relatively short exposure time comparing to previous Chandra and XMM observations, the spectra can only be best fitted with an absorbed power-law model. The long-term time-resolved spectra indicate that there is no obvious spectral change, consistent with the color-color diagrams and hardness-intensity diagrams. We also analyze their long-term lightcurves. Both sources exhibit long-term flux variability (i.e. days to months) with an observed luminosity in excess of 1e39 erg/s. In addition, Holmberg IX X-1 shows a possible quasi-periodic variability on a timescale of 30 days. However, the power spectrum indicates that it may be due to a red noise that needs to be confirmed with more monitoring observations. We will compare with Galactic X-ray binaries, and discuss the possible origins of the observed variability and the nature of the central compact object.

High Energy Emission From Pulsar Magnetospheres

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ABSTRACT

The study of emission from rotation-powered pulsars is undergoing a major advance with the successful launch of the two gamma-ray space telescopes, AGILE and Fermi. Theoretical attempts to explain these high-energy emissions have concentrated on two scenarios: The slot-gap (SG) model, an extension of the conventional polar-cap model into the higher altitudes, and the outer-gap (OG) model in which the gap is located typically a few hundred neutron-star radii away from the star. In this talk, I will solve the electrodynamics of particle accelerators from the set of Maxwell and Boltzmann equations for the first time and demonstrate that (1) the SG model requires an unnatural assumption on the rotationally induced, so-called 'Goldreich-Julian charge density', (2) the SG model predicts too small gamma-ray fluxes compared to observations, (3) the obtained, numerical solution corresponds to a quantitative extension of the traditional OG models and reproduces the observations. I apply this general scheme to representative gamma-ray pulsars and discuss their physical properties and detect abilities.

LOT and SMARTS Observations of a Special Kind of Supernovae: SN2008ip and SN2009au

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ABSTRACT

Type IIn supernovae are the type of core collapse supernovae with narrow H emission lines in their spectra. SN2008ip and SN2009au are two bright SNe IIn in last five months. SN2008ip, with mag= 15.7 at discovery, was discovered on 2008.12.31 in host galaxy NGC 4846 with z= 0.015124. SN2009au, with mag=16.4, was discovered on 2009.3.11 in host galaxy ESO 443-G21 with z= 0.009404. We are observing these two SNe to obtain their optical and IR light curves by SLT and LOT of Lulin Observatory (SN2008ip) and the SMARTS 1.3m telescope of CTIO (SN2009au). In this work, we will provide an update of our follow-up observations and comparison of their light curves with those of several other SNe IIn like SN1988Z and SN2006tf.

Searching for the Progenitors of Core-Collapse Supernovae in Archive Data

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ABSTRACT

There are several tens progenitors of different types of supernovae have been identified. The stellar origins of SNe are therefore still very uncertain and have remained as a key issue in this field. The nearby galaxy, NGC6946, provide us a good opportunity to study SN progenitors. It has a very high SNe production rate. NGC 6946 has produced 3 SNe (SN 2002hh, 2004et and 2008S) over the last 20 years. In this work, we have examined the archived images of NGC 6946 from HST, Subaru, VLT ...etc, with a view to find progenitors of these SNe. A preliminary report will be given here.

The Investigation of GRBs and Large Scale Structure

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ABSTRACT

We investigate the relation of Gamma ray bursts (GRBs) and the large-scale structures of the universe. The GRBs are short and intense gamma ray pulses. GRBs are expected to trace the large scale structure (Lamb & Quashnock 1993; Quashnock 1996). In this poster, we use Sloan Digital Sky Survey (SDSS) data to investigate the possible relationship between GRBs and the large-scale structure. We obtain 18 nearby GRBs ($z < 1$) that are covered by SDSS and use the photometric redshifts to probe the galaxy distribution around these GRBs. We discover three GRBs located in density-enhanced regions. There are only two short GRBs in our samples and both of them are located in the dense region. This suggests that short GRBs have strong correlation with the large-scale structures.

Lulin One-meter Telescope Observations for Black Hole Binaries Swift J1753.5-0127 and A0620-00

C. H. Wu（吳清雄）; Y. Chou（周翊）; T. C. Yang（楊庭彰）; C. P. Hu（胡欽評）;P. Cheng（鄭寶玲）; T. J. Li（李姿蓉）; P. Hsu（徐鵬英）; C. J. Chien（簡淨茹）;W. Y. Chang（張瑋芸）
Graduate Institute of Astronomy, National Central University, Taiwan, R.O.C

ABSTRACT

We report our multi-band photometry (V, R and I) observation results for the black hole binaries Swift J1753.5-0127 and A0620-00 using Lulin one-meter telescope (LOT). The transient X-ray source Swift J1753.5-0127 is considered as an accreting black hole system with a late type mass losing star. The light curves of these three bands show complex modulation morphology. The power spectra show strong ~3.2 hrs periodicity in all three bands. A distinct analysis method, combined with Lomb-Scargle periodogram and multi-frequency sinusoidal fitting, was applied to all the light curves to further reveal its

periodicity. The best period evaluated from this method is 3.2526±0.0032 hrs, consistent with the one proposed by Zurita et al. (2008) (3.2454±0.0080 hrs). After removing this ~3.2 hrs modulation, no clear side band is found in the spectra of residual light curves so the nature of this variation (orbital or superhump) is still uncertain although Zurita et al. (2008) claimed that it is superhump modulation from its complex modulation profile. On the other hand, we also performed multi-band observations for A0620-00 with LOT in November and December, 2008. The same analysis technique was applied and yielded a period of 7.75134±0.00105 hrs, consistent with the orbital period proposed by McClintock & Remillard (1986) (7.75234±0.00001 hrs). No other significant signal was detected after removing the orbital variation. Therefore we concluded only orbital modulation appears in the light curves of A0620-00. More LOT observations for the black hole binary Swift J1753.5-0127 will be made this year to further study its origin of variation.

An ULX in Mrk1434: The First Intermediate-Mass Black Hole Candidate in a Blue Compact Dwarf Galaxy?

Yi-Jung Yang; Albert Kong
National Tsing Hua University

ABSTRACT

We report the identification of an ultraluminous X-ray source (ULX) in the blue compact dwarf (BCD) galaxy Mrk1434 with Chandra. From an archival Chandra ACIS-I observation of the Lockman Hole, a luminous X-ray source was detected in the near-central region of Mrk1434 with an X-ray luminosity of 2e40 ergs/s (assuming a distance of 33.8 Mpc), which is much higher than the Eddington limit for a typical stellar-mass black hole. The preliminary spectral analysis shows that the spectrum is dominated by a power-law component (best fitted with an absorbed power-law model), and the photon index is around 1.76, which is similar to several intermediate-mass black hole (IMBH) candidates (i.e. M82 X-1). By performing astrometry with Chandra image and the optical image taken from Sloan Digital Sky Survey, we found that the X-ray source is clearly off center, and is approximately 2.5 arcsec away from the center, ruling out the possibility of an AGN. The estimated column density is 7.5e19 cm^{-2}, which is consistent with the Galactic column density along the line of sight towards Mrk1434, indicating that the source has very low chance of being a background AGN. The resultant analysis makes the ULX a strong candidate of IMBH, and it is also the first IMBH candidate ever found in a BCD galaxy. Further observations will provide us important insight to reveal the nature of the ULXs. Alternately, the studies of such systems will also help us linking the relation between metal-poor starburst galaxies and formation of IMBHs.

Indicators for Cluster Survivability in a Dispersing Cloud

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ABSTRACT

During the dispersion of its natal cloud, the embedded star cluster tends to loosen up and may become unbound. It is generally agreed upon that the cluster will be destroyed if the star formation efficiency (SFE) is lower than 30%. We re-examine this problem by a large survey of *N-body* simulations. We find that SFE is not a good indicator of survivability for most of the cases. We propose to use the cluster-cloud mass ratio in the inner part of the cluster as a better indicator. We comment on the physics behind our proposal. We present CO observations of circum-nuclear molecular gas in the nHBLRSy2 (non Hidden Broad Line Region Seyfert 2) galaxy NGC 3982. There is a question, how do molecular gas in host galaxy be transported to central region of the AGN. Even all nuclei of AGNs are believed to be based on unification model, but different circularnuclear environment may influence on origin of AGN type. Using Submillimeter Array (SMA) observation, we trace CO structures in central region and compare with multiwavelength observation to check if the relation does exist in this target.

CO (J=2-1) Observations in the Central Region of NGC 3982

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中央天文所

ABSTRACT

We present CO observations of circum-nuclear molecular gas in the nHBLRSy2 (non Hidden Broad Line Region Seyfert 2) galaxy NGC 3982. There is a question, how do molecular gas in host galaxy be transported to central region of the AGN. Even all nuclei of AGNs are believed to be based on unification model, but different circularnuclear environment may influence on origin of AGN type. Using Submillimeter Array (SMA) observation, we trace CO structures in central region and compare with multiwavelength observation to check if the relation does exist in this target.

Deep CO(1-0) Observation of the Starburst Galaxy NGC 3628

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ABSTRACT

Starburst galaxies have strong star forming activities, especially massive star formation, in the central regions. Since massive stars eventually explode as supernovae and input large energy into the surrounding interstellar medium, starburst galaxies are expected to have galactic-scale superbubbles and outflows. Because stars form in molecular gas, to study the evolution of molecular gas properties will help us to understand the star formation activities in starburst galaxies. Starburst galaxy NGC 3628, one of the members of the interacting Leo Triplet, is a nearby, edge-on, infrared luminous spiral galaxy. Hundred parsec-scale X-ray outflow, H-alpha outflows, and HI plume have been detected. CO molecular emission has also been observed in the past. Our Nobeyama Millimeter Array (NMA) observations provide a better spatial resolution with $2''.9 \times 2''.4$, better velocity resolution with 5.2 km s^{-1}, and better rms noise in channel maps with 9.86 mJy $beam^{-1}$. We detected two diffuse and extended structures away from the galactic disk. The characteristics of these two diffuse emissions will be present to show the star formation activities in the central disk of NGC 3628.

Molecular Gas Properties in the Starburst Ring of The Barred Galaxy NGC 1097

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[3] Graduate Institute of Astronomy, National Central University

ABSTRACT

Using the previously published CO (J=1-0) and CO (J=2-1) data of the barred spiral galaxy NGC 1097, we study the properties of molecular gas at the interface between the dust lanes and the starburst ring. The velocity widths of both lines exhibit an azimuthal variation around the starburst ring in good qualitative agreement with theoretical gas dynamical models; the line width is broadest where the dust lanes join the starburst ring. We, however, did not find any azimuthal variation in the brightness temperature ratio between the CO (J=2-1) and CO (J=1-0) lines (an indication of the excitation condition of the molecular gas); this ratio is constant to within measurement uncertainties with a value between 1 and 2 around the ring. Instead, we found a correlation between the intensities of the thermal cm-wave radio continuum (tracing star formation) and the CO (J=2-1) line, suggesting that the heating of the molecular gas in the starburst ring is dominated by local star formation.

Poster Winner

Revealing the Nature of a very Luminous Globular Cluster X-Ray Source Bo375 in M31 Galaxy

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[2] Harvard-Smithosonian Center for Astrophysics

ABSTRACT

We present the results of observations of a very luminous M31 globular cluster (GC) X-ray source

Bo375 with Chandra, XMM-Newton, Suzaku and Swift. Bo375 is one of the most luminous GC X-ray sources in M31 (Andromeda Galaxy), and has a luminosity consistently above 1e38 ergs/s, which is much more luminous than typical GCs found in our own Milky Way galaxy (the brightest GC X-ray source in our Milky Way galaxy is in the order of 1e37 ergs/s). There are several possible explanations for such a high luminosity: 1) the source might contain multiple components; 2) the source radiation might be beamed; 3) the source might be an accreting black hole, and 4) the source might be an accreting neutron star. To investigate why Bo375 has such a high luminosity, we study the light curves, X-ray spectra, and timing properties of the source from the data taken by Chandra, XMM-Newton, Suzaku and Swift in detail. Previous observations showed that Bo375 has short-term and long-term variability. The Chandra HRC-I data also shows that the source is consistent with a single point source. In this poster, we will further show the new results from XMM-Newton, Suzaku and Swift, which might reveal the nature of Bo375, and of other luminous GCs in nearby galaxies.

Studies on X-ray Sources from Chandra Observations of Galactic Globular Cluster M92 (NGC6341)

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ABSTRACT

We analyzed two observations of M92 from the Chandra X-ray Observatory. We combined the two datasets with a total exposure of ~ 52 ks. With the combined observation, we detected 10 X-ray sources inside the half-mass radius (1.09 arcmin), while 5 of them inside the core radius (0.23 arcmin) of M92. The luminosities of the 10 sources are roughly within the range of 10E+30 - 10E+32 erg/s assuming cluster memberships. We fitted the spectra of the brightest sources with photon counts □ 150 within the half-mass radius and the color-color diagram showed that most of the X-ray sources have relatively hard spectral features. Furthermore, the short term light curves of the brightest sources do not show obvious variation. In order to study the possible formation mechanisms of the X-ray sources in M92, we need to identify these X-ray sources. Therefore, further information from optical observations is necessary for the identification and we will outline our ongoing works using data taken with the Hubble Space Telescope and CFHT.

Photometric Study of Morphologically Identified Merging Galaxies

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Graduate Institute of Astronomy, National Central University

ABSTRACT

We investigate the photometry properties of 321 morphologically identified faint merging galaxies in 6 square degree. The merging galaxies are identified morphologically in the Red Sequence Cluster Survey 2 (RCS2) of CFHT observations. We study the color property of these mergers and compare with the color diagrams produced by a set of empirical galaxy templates. We will also discuss the properties of the mergers in clusters and in field.

Merging Galaxy Database

Yi-Fan Lin

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ABSTRACT

本文介紹一個新的天體資料庫及其網頁查詢介面。使用 PHP 網頁語法及 My SQL 語法建製天體資料庫，內容可包含天體之座標、類型、照片等相關資料，目前資料庫包含 15,147 筆合併星系(Merging Galaxy)的資訊。使用者可透過網頁介面，輸入所要查詢的座標範圍，來搜尋範圍內的合併星系資料，未來可包含不同類型天體及使用不同的條件，輸入鍵值，來搜尋需要的資訊。

Fundamental Plane and Strong Lensing in MOND

[1] Yong Tian; [2] Mu-Chen Chiu; [3] Chung-Ming Ko

1 Department of Physics, National Central University

[2] The Scottish Universities Physics Alliance (SUPA), Institute for Astronomy, University of Edinburgh, Royal Observator

[3] Institute of Astronomy, Department of Physics and Center for Complex Systems, National Central University

ABSTRACT

In elliptical galaxies, the logarithms of the mass, the effective radius, and the velocity dispersion can be organized on a plane, the so called fundamental plane. Mass is important in understanding the relation and Newtonian dynamics faces some difficulties. In this contribution we examine this relation in MOND (MOdified Newtonian Dynamics), which is an alternative to dark matter. On the other hand, strong lensing provides an independent probe for the mass of the lens. We analyze SDSS ACS strong lensing data using relativistic MOND. Comparing the mass obtained by these two methods, we check the consistency of MOND.

On the Size Distribution of Elliptical Galaxies in SDSS

[1] Ting-Hung Peng; [2] Chung-Ming Ko

[1] Institute of Astronomy, National Central University

[2] Institute of Astronomy, Department of Physics and Center for Complex Systems, National Central University

ABSTRACT

Sloan Digital Sky Survey (SDSS) is a gold mine in studying properties of galaxies. We use Sample SQL Queries in SDSS Data Release 7 to select elliptical galaxies with spectroscopic information. About 100,000 galaxies with redshifts 0.2 to 0.5 are selected. In this contribution, we present the distributions of size, magnitude, ellipticity as a function of redshift and wavelength (we use SDSS g', r', i', z')

Poster Winner

Obscuration in Type 2 QSOs and Their Environments

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ABSTRACT

Type 2 QSOs are possibly at a key stage of galaxy evolution that could reveal the process to decide whether the output power of an active galaxy is in an accretion dominated or starburst dominated phase. In this work, we carry out a statistical analysis of several multiwavelength properties of optically selected type 2 QSOs to compare their characteristics with those of type 1 QSOs, the type 1 QSO and type 2 QSO samples are from the released catalogues based on SDSS database. Our analysis results show that the 2 types of QSOs have systematic differences in radio luminosity functions at 1.4 GHz, optical photometry, and dust obscuration indicated by *g-i* colour index, however there is no indication of difference in environments, namely, the number density of galaxies in neighboring 1.5 Mpc radius region. Furthermore, we derive the lower limit of neutral hydrogen column densities of selected bright type 2 QSOs using the ROSAT All Sky Survey (RASS).data, and compare the result with their *g-i* colour indices to discuss the nature of the obscuring material as well as its implication to QSO evolution.

Membership of Star Clusters Using the UCAC Proper Motion Data

Chien-Hui Kao（高千惠）; Wen-Ping Chen（陳文屏）
IANCU
ABSTRACT

Members in a star cluster share common location and motion in space, and are seen as grouping in the sky. We have conducted a feasibility study to make use of the USNO CCD Astrograph Catalog (UCAC), a CCD sky survey for stellar astrometry, to distinguish probable members in a star cluster against field stars. We present the methodology to use the UCAC data to select probable cluster members and illustrate with a few examples how this in turn improves the determinations of the age and distance of a star cluster.

The Luminosity Functions of Galaxy Clusters of High Merging Rates

Mei-Ling Huang; Chorng-Yuan Hwang
Graduate Institute of Astronomy, National Central University, Taiwan
ABSTRACT

We present the luminosity functions of several galaxy clusters with high merging rates. These galaxy clusters are selected based on morphological classification of merging galaxies in Red Sequence Cluster Survey 2 (RCS2). We identify nine regions with significant density enhancements of merging galaxies to be potential galaxy clusters. We first identify the new clusters by comparing the surface density in these regions with their neighborhood. The galaxy luminosity function (LF) of these clusters are subsequently constructed and compared with the LF of well-relaxed clusters to investigate the evolution of galaxy clusters.

Investigation into Five Rydberg Series up to High Principal Quantum Numbers n of Magnesium in MCRRPA

[1] Cheng-Liang Lu; [2] Ju-Tang Hsiao; [1,2] Keh-Ning Huang
[1] Department of Physics
[2] Institute of Atomic and Molecular Sciences Academia Sinica
ABSTRACT

The recent experimental work given by Wehlitz et al. employing monochromatized synchrotron radiation had measured with high photon energy resolution the doubly excited states of Mg below the Mg+(3p) threshold. And had obtained the newly observed 3pnd 3X (n = 9－15) series. We have compared our calculations with experimental data and recognize these series as the 3pnd 3D series.

Report on Lulin Spectroscopy School 2009

Kinoshita Daisuke
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ABSTRACT

The spectroscopy is a powerful method to investigate the physical properties and chemical compositions of astronomical objects. The low-resolution spectrograph ``Hiyoyu'' is now serving as one of open-use instruments at Lulin observatory in Taiwan. In order to encourage more graduate students to use this instrument, first Lulin Spectroscopy School was held at the university main campus and Lulin observatory of National Central University. This school consists of two parts, lectures and exercises at the university main campus prior to the training observation, and observations and data reductions at Lulin observatory. At the university main campus, lectures on the very basics of astronomical spectroscopy were given, then participants actually prepared for the observation by drafting observing plans, discussing calibration strategies, and making finding charts, etc. At Lulin observatory, observations were carried out by participants themselves for three nights. The spectroscopic observations for different types of stars and asteroids were conducted. At daytime, participants reduced and analysed the data they obtained. Basically, it was a success. Students selected targets, prepared an observing schedule, carried out observations, and analysed data. For some students, it was the first time for them to do astronomical spectroscopy, and they now know rough idea on what they can do with a spectrograph. For some students, it was an opportunity to know more about spectroscopic observation. I report on the activity of Lulin Spectroscopy School.

Proton-impact Ionization Process of Hydrogen-like Ions

[1,2] S. F. Lin; [1] H. L. Sun; [1] J. T. Hsiao; [1,2] K. N. Huang
[1] Institute of Atomic and Molecular Sciences, Academia Sinica
[2] Department of Physics

ABSTRACT

We use the two-potential distorted wave approximation to calculate single-differential and total cross sections of proton-impact ionization of hydrogen-like ions. The biggest problem of proton-impact ionization is that the requirement of lots of computer memory, which is due to the rapidly oscillatory wave functions caused by the massive mass of proton. By using the variable transformation, we can solve this problem with fewer computer memory and time than it used to be. Such that, we can calculate single-differential and total cross sections of proton-impact ionization of hydrogen-like ions precisely and quickly.

Photoionization of Be, B^+, C^{2+}, N^{3+}, O^{4+}, and F^{5+} in the MCRRPA Theory

[1] Ju-Tang Hsiao; [1,2] Keh-Ning Huang
[1] Institute of Atomic and Molecular Sciences, Academia Sinica
[2] Department of Physics

ABSTRACT

The multiconfiguration relativistic random-phase approximation theory is applied to the valence-shell photoionization along the Be isoelectronic sequence. Photoionization cross sections between $(1s^2 2s)^2 S_{1/2}$ and $(1s^2 2p)^2 P^o_{1/2}$ ionization thresholds are calculated. There are five Rydberg series of doubly excited states that manifest themselves as autoionization resonances in the photoionization cross section. A comparative study of Be, B^+, C^{2+}, N^{3+}, O^{4+}, and F^{5+} is presented.

The influence of the Science Picture Books on Changing the Concept about Moon for Children

科學圖畫書讀書會對幼兒月亮相關概念改變之影響

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國立台東大學幼兒教育學系

ABSTRACT

The purpose of this study is to explore children's reading comprehension of the picture books on the theme of the moon by using study circles; and study how to opetare study circles successfully further. We expect to ask for thirty-six Participants with 5-year-old. The study show that the children who have join the study circles usually get higher scores than others. In addtion, most children get higher scores after they join the study circles by using the picture books on the theme of the moon. The results of this study show that the number of children who attend the study circles is the most important factor which affect the opetation of the study circles. Further, some factors such as guide-reading skill, detail interpretation, and the stratety of asking question, these factors affect the operation if the study cirecles to be successful or not. Finally, some suggestions were made.

key words: Reading comprehension、Information picture books、Concepts of the moon.

Educational Oral Presentations / 教育研討會報告

多媒體在高中天文教學的經驗分享

陳麗妃
國立花蓮高中

摘　要

以自製的三則動畫，與網路、電視所蒐集的影片爲例，介紹多媒體在天文教學的運用。

自製動畫：

1. 天文望遠鏡的成像：天文望遠鏡的成像（倒立）、雙筒望遠鏡成像（正立）。
2. 太陽日 V.S.恆星日；朔望月 V.S.恆星月。
3. 星座盤： A.觀察天體的周日、周年運動　B.判斷太陽所在位置及日出、日落時刻。

網路、電視取得的影片： 1. 望遠鏡的「自調光學」科技 2. 行星（地球）的誕生。

臺灣大型天文計畫介紹

陳文屏
國立中央大學天文所

摘　要

臺灣目前正積極參與多項大型天文計畫，包含括鹿林兩米望遠鏡、宇宙微波背景輻射陣列（AMiBA）、次毫米波陣列（SMA）、Atacama 大型毫米及次毫米陣列(ALMA)、加法夏天文台（CFHT）合作計畫、康卜吞成像光譜儀（NCT）、泛星計畫（Pan-STARRS）和中美掩星計畫（TAOS）等。在此將透過本次演講，爲大家介紹這些計畫的內容與執行現況。

臺北市數位遠端遙控天文台的建置與推廣

[1] 吳昌任; [2] 林詩怡
[1] 臺北市立南湖高中
[2] 臺北市立中崙高中

摘　要

夜間觀測地點是否安全、儀器架設與校正問題，以及隔天白天需要上課等因素，使得一般高中生很難在非寒、暑假的學期當中獨自從事天文研究，於是我們跨校合作向臺北市教育局資訊室提出「臺北市數位遠端遙控天文台實驗計畫」，在教育局與學校的支持下，於 2005 年六月順利建置完成臺灣第一座真正能夠遠端遙控的圓頂天文台，取名爲 Remote Observatory of Taipei，縮寫爲 ROoT（根），希望藉由數位遠端遙控天文台的設立，讓天文在臺北市扎根。

爲了讓使用 ROoT 的學生能藉此機會充實天文知識，我們還設計了一套完整的觀測與分析研究的天文實驗室課程，內容從天文知識到 CCD 影像處理與分析，讓參與的學生能在得到觀測資料後立即做基本的分析，透過不斷改良的簡易教具，也讓學生對天文知識有更正確的瞭解。

自由軟體在天文教育上的應用-以 Stellarium 及 Celestia 為例

游大立
國立彰化高級中學地球科學教師

摘　要

自由軟體在近幾年來隨著網際網路的擴展而快速發展。許多軟體得以透過網際網路將全世界有志之士的成果整合起來。其中在天文教育的領域中，也有許多相關的軟體逐漸發成熟，例如：Stellarium、Celestia……等。有一部份自由軟體發展出在不同作業系統平臺的執行碼。有別於一般商用軟體，自由軟體沒有商業廣告的促銷，因此知名度不高，未受到一般使用者的注意。自由軟體具有可以自由取得軟體、程式碼以及自由散播的特性，對於教育的應用而言，可以大節省教育經費。因此在天文推廣教育上，自由軟體更是要加以推廣的。

Stellarium 是一套星圖軟體，可以模擬從各個太陽系行星、各個緯度、廣範年代、不同日期時刻所見的星象。可以模擬歲差進動、行星動態、日月食等特殊天象。在天文教育上，可以用來示範天體運動的特性，不同緯度所見星空的運動特徵，太陽東升西落的季節變化，不同緯度所見太陽運行的四季變化。在基礎的星座辨示教學中，因爲有星座圖繪以及星座連線，更容易讓初學者快速認識星座。搭配地平方位坐標的概念，可以根據電腦螢幕上天體的坐標，快速地在實際天空中找到。這套軟體更可以搭配半球形天幕以及魚眼投影機，組合成一套數位星象儀，已有些教育單位正在使用中。

Celestia 是一套以 3D 投影的方式呈現宇宙的立體結構。有別於一般的星圖軟體是從地面上觀察星空，這個軟體可以在宇宙中移動，從不同的位置來觀察宇宙結構。軟體預先搭配的資料庫，對於銀河系、星座及太陽系的結構可以得到正確的概念。這套軟體更可以擴充更多的外加模組(add-ons)，來增加更多的天體，例如：人造衛星的軌道資料、SDSS 的遙遠星系資料、更多太陽系

小行星的資料、科幻電影的太空船立體影像資料等，相當多種的擴充資料庫。Celestia 更可以將整個畫面錄影或截圖下來，提供教學上重覆使用。

上述這兩套軟體，對於一般天文推廣教育而言，是相當實用的軟體。在過去實際的教學活動中，在具有電腦廣播硬體設備的電腦教室進行，每一套軟體從下載、安裝、基本的操作使用並且引導學生使用這些軟體在學習天文知識，各需要花費 3-4 小時。

國小五年級學生對天文感興趣議題及已知概念之調查

邱國偉、黃湘筠、趙毓圻
國立台北教育大學自然科學教育研究所

摘　要

本研究之目的在調查國小五年級學生對天文感興趣之議題，以及已知天文概念二者在九年一貫課程範圍內外分布之情形，並進一步分析其迷思概念。研究以選取台北縣及桃園縣共三所國小合計 174 名五年級學生，以個別作答方式使學生提出對天文有興趣之開放問題，有關天文已知概念之敘述則以小組討論之方式進行。

研究發現：(1)學生對天文感興趣的問題及已知概念，呈現超出課程內容的廣泛分布；在出現比例最高的部分(2)課內問題爲「恆星光熱」、課內敘述爲「太陽系成員」；(3)課外問題及敘述均爲「星體誕生與毀滅」；迷思概念比例部分(4)課內外比例最高分別爲「太陽系成員」及「星體誕生與毀滅」。

關鍵字：天文教育、迷思概念、學習動機。

國小四年級學生對太陽四季仰角方位圖之概念初探

吳潔蓉, 林宇涵, 趙毓圻
國立台北教育大學自然科學教育研究所

摘　要

本研究聚焦於太陽單元中的「四季仰角方位圖」，探究四年級學生對此圖產生的概念爲何。以台北市某國小 27 名學生爲樣本，第一階段使用開放式問卷使學生進行對太陽四季仰角方位圖進行描述，依此作答及參酌文獻形成第二階段結構式問題，除分析全體學生之答題外，並依自然科學業成績分爲高、中、低三層，挑選概念具特殊性之各三名學生進行深入晤談。

研究結果發現學生對四季仰角方位圖呈現之概念如下：(1)無法判斷該圖所呈現之方位；(2)能由日常生活中地「球」之用語推斷地球是圓形，或直觀的由圖判斷地球爲半圓形；(3)從圖中獲得一、三、九不同資訊的太陽數目；(4)將天球視爲地球的一部份；(5)從書籍中得到地繞日的觀念，或直觀的判斷太陽繞著地球旋轉。

關鍵字：地日運動、概念學習。

攬月摘星九年夢–談社區大學中的天文社教推廣

洪景川
臺北市立天文科學教育館

摘　要

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   （2） 士林、中山社區大學「天文與人文」、「天文觀測－星空之美」
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8. 臺北市立天文科學教育館在社區大學天文教育中的角色
9. 社區大學天文課的瓶頸與對策

10. 問題與討論

International Year of Astronomy in Hong Kong and Cooperation with Taiwan

Sze-leung Cheung
International Year of Astronomy 2009 Hong Kong League

ABSTRACT

The International Year of Astronomy is a great chance for promoting astronomy to the public and students. Besides, establish new local and regional networks is another keyframe idea in the IYA2009 campaign, joint Hong Kong - Taiwan cooperations will be proposed.

中華民國天文學會 2009 年研討會論文摘要作者索引

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